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37 CFR 1.8(a)

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Date of Deposit: 10-4-01 By: Susi Stephens

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ATTORNEY DOCKET NO. **046362.07001.0003**

In re Application of:
J. ROGER KELLEY

Serial No.: **09/849,078**

Examiner:

Filed: **05/04/2001**

Art Unit:

For: **REGULATORY ONLINE MANAGEMENT SYSTEM**

PRELIMINARY AMENDMENT

Box Non-Fee Amendment
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Please amend the above-identified application as follows:

IN THE CLAIMS

Please add Claims 15, 16, 20, and 22 below and replace Claims 13, 14, 19, and 21with the following:

13. (Amended) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating hydrocarbon emissions from storage tanks:

$$L_T = L_S + L_W$$

$$L_S = 365 V_V \; W_V \; K_E \; K_S$$

$$V_V = \frac{\pi}{4} D^2 (H_S - H_L + H_{RO})$$

$$W_V = \frac{M_V P_{VA}}{R T_{LA}}$$

$$T_{LA} = .044 T_{AA} + 0.56 T_B + 0.0079 aI$$

$$T_B = T_{AA} + 6a - 1$$

$$K_E = \frac{dT_V}{T_{LA}} + \frac{dP_V - dP_B}{P_A - P_{VA}}$$

$$dT_V = .072 dT_A + 0.028 I$$

$$K_S = \frac{1}{1 + 0.053 P_{VA} H_{VO}}$$

$$H_{VO} = H_S - H_L + H_{RO}$$

$$L_W = 0.0010 M_V P_{VA} Q K_N K_P$$

Symbol	Name	Description	Type	Source
π	Pi	Constant dimensionless factor = 3.1415	Numeric	Mathematical constant (given)
a	Tank paint solar absorbence factor	Dimensionless empirical factor which has been established through experience.	Numeric	Reference from Table 12.3-7 in AP42 reference and based on color. Stored in System Library.
D	Tank diameter	Cross sectional linear measurement of the cylindrical tank. Units=linear	Numeric	Client data stored in System Database
H_L	Liquid Height	Average daily tank gauge reading which shows how much is in the tank. Units=linear (e.g. ft)	Numeric	Client data stored in System Database
H_{RO}	Roof Outage	Linear measurement of tank roof height measured from the vertical edge of the tank shell to the top of the dome or coned roof. Units = linear (l)	Numeric	Client data stored in System Database
H_S	Shell Height	Linear measurement of tank height excluding the height of the roof section of the tank. Units = linear (l)	Numeric	Client data stored in System Database

Symbol	Name	Description	Type	Source
H_{VO}	Vapor Space Outage	The height of the inside tank space minus the liquid level in linear units, e.g. ft	Numeric	Result of Equation 3.1.10
I	Daily solar insolation factor	Empirical factor based on tank materials and conditions. Units = BTU / ft^3 - day	Numeric	Referenced from Table 12.3-6 in AP42 reference. Stored in System Library.
K_E	Vapor space expansion factor	Dimensionless empirical factor used to calculate standing losses in Equation (1)	Numeric	Result of Equation 3.1.7
K_N	Turnover factor	Dimensionless empirical factor	Numeric	Taken from Figure 12.3-6 in AP42 reference. Stored in System Library.
K_P	Working loss product factor	Dimensionless empirical factor which is product specific, i.e. 0.75 for crude oil and 1.0 for all other organic liquids.	Numeric	Included by reference. Stored in System Library.
K_S	Vented Vapor Saturation Factor	Dimensionless factor used to calculate the Standing Storage Losses.	Numeric	Result of Equation 3.1.9
L_S	Standing Losses	Hydrocarbon air emissions from crude and condensate above ground storage tanks that are given off while the tank is standing idle (not filling and emptying) and contains some quantity of fluid. Measured in lbs/hr, lbs/day, and tons/year.	Numeric	Result of Equation 3.1.2
L_T	Total losses	Hydrocarbon air emissions from crude and condensate above ground storage tanks that are a sum of the working and standing losses as described above. Measured in lbs/hr, lbs/day, and tons/year.	Numeric	Result of Equation 3.1.1
L_W	Working Losses	Hydrocarbon air emissions from crude and condensate above ground storage tanks that are given off during operations (filling and emptying) and contains some quantity of fluid. Measured in lbs/hr, lbs/day, and tons/year.	Numeric	Result of Equation 3.1.11

Symbol	Name	Description	Type	Source
Mv	Vapor Molecular Weight	Molecular weight or the weight of an Avogadro's number of molecules of the gases in the vapor space volume. Units = mass/mole (e.g. lb/lb mole)	Numeric	Taken from reference tables in the AP42 reference. Stored in System Library.
P_A	Atmospheric pressure	Standard ambient atmospheric pressure as measured via barometer, e.g. 14.7 psia	Numeric	Constant by reference. Stored in System Library.
dP_B	Breather vent pressure setting range.	The range in pressures at which the tank vent or hatch will relieve under the pressure of its contents.	Numeric	Client data stored in System Database. Otherwise the program will provide a default value if the user chooses.
dPv	Daily vapor pressure range	The range (or change) in the vapor pressure caused by the variance in maximum and minimum daily ambient temperatures. Provided by reference in pressure measurements.	Numeric	Derived from Figure 12.3-1 and Table 12.3-6 in AP42 reference. Stored in System Library.
P_{VA}	Vapor pressure	True vapor pressure of the liquid at the average liquid surface temperature. Units = force / unit area (f/l^2) (lbs/ $inch^2$)	Numeric	Vapor sample data stored in System Database or table in AP42 reference stored in System Library.
Q	Annual net production through-put	The annual volume of hydrocarbons, e.g. crude oil, that is stored in the tank being considered. This figure is taken from actual lease production volumes. Volumetric units, e.g. bbls	Numeric	Client data stored in System Database
R	Ideal Gas Constant	Ideal gas constant calculated as (standard atmospheric pressure - ideal molar volume of gas / mole - standard temperature) (e.g. psia - ft^3 / lb-mole - °R (Rankine) = 10.731)	Numeric	Calculated from constants / Almost always used in USA as 10.731. Stored in System Library.
dT_A	Daily average temperature range (°R ,°K)	The difference between daily minimum and maximum temperatures taken from Table 12.3-6 as determined by regional location.	Numeric	Taken from Table 12.3-6 in AP42 reference. Stored in System Library.
T_{AA}	Daily average ambient temperature	Average of daily maximum and minimum ambient temperatures. Measured in °R or °K.	Numeric	Table 12.3 in AP42 reference. Stored in System Library.

Symbol	Name	Description	Type	Source
T_B	Liquid bulk temperature	Liquid bulk temperature at standard temp Units = °R or °K	Numeric	Result of Equation 3.1.6
T_{LA}	Daily average liquid surface temperature	The average temperature measured at the surface of the liquid in the tank. In this case the temperature is calculated from ambient temperatures rather that measured. Units = °R(Rankine)	Numeric	Result of Equation 3.1.5
dTv	Daily vapor temperature range	The daily range in temperature of the vapor in the vapor space of the tank as described above; calculated.	Numeric	Result of Equation 3.1.8
Vv	Vapor space volume	Volumetric calculation of the average amount of space in the tank (overhead) that is not occupied by liquids. Measurement = l^3	Numeric	Result of Equation 3.1.3
Wv	Vapor density	Calculated density of the gases(vapors) in the vapor space calculated in equation (1)(a) Units= mass/unit volume (m/l^3) (e.g. lb/ft^3)	Numeric	Result of Equation 3.1.4

14. (Amended) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating hydrocarbon emissions from internal combustion engines:

$$\sum_{i=1 \text{ to } n} \frac{EF_i\ g}{1\ hp\ hr} \times \frac{\text{Rated } hp_i}{1} \times \frac{24 \text{ hrs}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ lb}}{453.6 \text{ g}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \frac{\text{Emissions tons}}{\text{year}}$$

Symbol	Name	Description	Type	Source
EF	Emission Factor g/hp/hr	The amount of an individual pollutant that will be generated per horse power hour of operation, e.g. 2.0 grams NOx generated in grams per hp per hour.	Numeric	Provided by the user or obtained from the equipment data base by the id number or model of compressor
HP (hp)	Horse power rating	The power rating of the compressor in horse power per hour	Numeric	Provided by the user or obtained from the equipment data base by the id number or model of compressor

15. (New) The method of claim 14, wherein the primary formula is repeated for each of the following pollutants:

NOx	Nitrous Oxides	Nitrous oxide emissions	Calculated from AP-42 emission factors or manufacturers data.
CO	Carbon Monoxide	Carbon monoxide emissions	Calculated from AP-42 emission factors or manufacturers data.
SO_2	Sulfur dioxide	Sulfur dioxide emissions	Calculated from AP-42 emission factors or manufacturers data.
PA or PM_{10}	Particulates	Particulate emission from fuel combustion	Calculated from AP-42 emission factors or manufacturers data.
VOCnm	Non-methane Volatile Organic Compounds	Measurement of emissions of VOC's as tons per year.	AP-42 emission factors or manufacturers data.

16. (New) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating hydrocarbon emissions from external combustion units:

$$\sum_{i=1 \text{ to } n} \frac{mmBTU_i}{hr} \times \frac{1\ SCF}{\text{Fuel Heat Value in } BTU} \times \frac{EF\ lbs}{mmSCF} \times \frac{24 \text{ hrs}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \frac{\text{Emissions tons}}{\text{year}}$$

Symbol	Name	Description	Type	Source
EF	Emission Factor lb / mmscf	Amount of pollutant species generated per unit of fuel used or burned, e.g. lbs (pounds) per mmscf (Million standard cubic feet) of gas burned.	Numeric	Client data stored in System Database
mmbtu	BTU rating of the unit	The size of the combustion unit as measured in BTU's per hour. mmbtu = million British Thermal Units	Numeric	Client data stored in System Database

19. (Amended) The method of claim 18, wherein the primary formula is repeated for each fitting in each piece of equipment:

Symbol	Name	Description	Type	Source
EF	Emission Factor	Amount of volatile organic emissions generated per fugitive component or source. E.G. lbs / hour / source	Numeric	Provided by reference from AP42 and SOCMI.
No. of components, (src)	Number of components	Actual number of each source component at the facility, e.g 355 valves, etc.	Numeric	Provided by the user or obtained from Client data stored in System Database or equipment data stored in System Library
VOC%	VOC Concentration in the affected stream	The concentration of VOC (volatile organic hydrocarbon compounds) defined as any compound with C3+ hydrocarbons as identified in the gas analysis and as calculated by volume %.	Numeric	Calculated from the gas analysis for this facility.

20. (New) The method of claim 18, wherein the mathematical database includes the primary calculation formula for calculating emissions for glycol dehydration units, wherein:

Symbol	Name	Description	Type	Source
	Unit Description	Case name and case description used to retrieve case files from the GRI program. This name will also be identified by a facility ID number and an equipment ID number.	Text	Provided by the user or taken from the facility data base as a facility name.
	Annual Hours of Operation	Number of hours the unit operates annually, e.g 8760 hrs = 1 year	Numeric	Input by user or user data base.
	Gas Composition	Percentages of all components in the gas stream. Individual values input separately from gas analysis.	Numeric and text	Gas analysis provided by user or from Client data stored in System Database
mmscf / day	Dry gas flow rate	The volumetric flow of the sales gas stream in volumetric units per day (e.g. mmscf/day or million standard cubic feet per day)	Numeric	Production data from user or Client data stored in System Database

Symbol	Name	Description	Type	Source
lb / mmwscf	Dry gas water content	The target final concentration of water in the sales gas stream, in the USA the default value is 7.0 lb / mmscf	Numeric	Client data stored in System Database or accepted by default
	Absorber stages	Number of actual equilibrium stages in the contactor; may be chosen, if known, by the user as an alternative entry to the dry gas water content described above.	Numeric	Chosen by user
	Lean TEG/ EG flow rate	The pumping rate of the lean or fresh tri-ethylene glycol (or ethylene glycol) solution in gallons per minute	Numeric	Client data stored in System Database
	Water content	The allowable water concentration in the lean or fresh glycol stream. A default value of 1.5% may be chosen if the user does not have this value	Numeric	Client data stored in System Database or chosen by default
	Re-circulation ratio	The gallons of glycol solution circulated per pound of water removed from the wet gas stream if known. May be chosen in place of the lean TEG/EG flow rate. Default value of 0.3 may be chosen in the program.	Numeric	Client data stored in System Database
	Wet Gas Temperature	Temperature of the incoming wet gas stream in °F.	Numeric	Client data stored in System Database
	Wet gas pressure	Pressure of the incoming wet gas stream in psig.	Numeric	Client data stored in System Database
	Glycol pump type	May be gas driven or electric	Text	Client data stored in System Database
ACFM / gal	Gas driven pump volume ratio	ACFM (air cubic feet per minute) gas / gallon per minute glycol pumped (only for gas driven pumps) May choose default values of 0.03 for wet gas pressures greater than 40 psig and 0.08 for units with wet gas pressures less than 400 psig.	Numeric	Client data stored in System Database
	Flash Tank	Yes or no question. Is a flash tank involved with this unit.	Text	Client data stored in System Database
	Flash tank temperature	Operating temperature of the flash tank if used in °Fahrenheit (°F)	Numeric	Client data stored in System Database
PSIG	Flash tank pressure	Operating pressure of the flash tank if used. Psig (pounds per square inch gauge)	Numeric	Client data stored in System Database

Symbol	Name	Description	Type	Source
	Stripping gas option	Yes or no question. Is a gas stream used to remove the hydrocarbons from the glycol vent stream?	Text	Client data stored in System Database
	Stripping gas flow rate	Flow rate of the stripping gas stream, scfm	Numeric	Client data stored in System Database
	Control device option	Choose a control device as either a vent condenser or vapor incinerator, or choose no control device.	Text	Client data stored in System Database
	Vent condenser temperature	Operating temperature of the vent condenser (if used) in °F	Numeric	Client data stored in System Database
	Vent condenser pressure	Operating pressure of the vent condenser (if used) in absolute pressure, e.g. psia	Numeric	Client data stored in System Database
	Incinerator ambient air temperature	Average ambient air temperature for the location in °F	Numeric	Selected from climatic data stored in System Library
	Excess oxygen	% excess oxygen used in combustion process if a vapor incinerator is chosen as a control device.	Numeric	Provided by the manufacturer of the combustion unit and included in the System Library
	Combustion efficiency	% efficiency of the vapor control incinerator unit.	Numeric	Provided by the manufacturer of the combustion unit and included in the equipment data base.
VOCs	Volatile Organic Compounds	Measurement of emissions of VOC's as tons per year from the Glycalc Program Printout in tons/year	Numeric	Glycalc® program output
HAPs	Hazardous Air Pollutants	Volumetric measurement of a group of air constituents that have been determined by the Environmental Protection Agency (EPA) to be considered categorically hazardous to health and the human environment. Measured in tons/year	Numeric	Glycalc® program output or information gained from the EPA speciation program for HAP's.

21. (Amended) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating flash emissions caused by the transfer of

higher pressure liquids from a process vessel to a storage tank of less pressure:

$$\log R_{st} = 0.4896 - 4.916 \log \gamma_{ost} + 3.496 \log \gamma_{sp} + 1.501 \log P_{sp} - 0.9213 \log T_{sp}$$

and the Vasquez Beggs GOR Correlation.

$$GOR = C1 \times SG100 \times (P_{str} + P_{atm})^{C2} \times e^{\frac{C3 \times {}^{\circ}API}{T_{gas}{}^{\circ}F + 460}}$$

$$SG100 = SG \times (1.0 + 5.912 \times 10^{-5} \times T_{gas}{}^{\circ}F \times \log \frac{P_{sep} + P_{atm}}{114.7}$$

Symbol	Name	Description	Type	Source
R_{st}	Stock Tank Gas Oil Ratio (GOR)	The ratio of the volume of gas generated per barrel of oil produced as a result of the pressure drop between the pressurized separator and the oil storage (stock) tank. Units = volume gas / volume oil, e.g standard cubic feet / barrel	Numeric	Calculated by Black Oil GOR equation, 3.6.1
γ_{ost}	Stock Tank Oil specific gravity	Measurement of the ratio of the weight of the oil relative to water at standard temperature and pressure. E.g. units = lb/gal per lb/gal or SG=6.5 lb/gal oil / 8.34 lb/gal water @STP = 0.78	Numeric	Calculated using the physical data of the materials being stored
γ_{sp}	Separator specific gravity	Measurement of the ratio of the weight of the air relative to	Numeric	Calculated using the physical data of the gas being measured
P_{sp}	Separator-pressure	The operating pressure of the vessel used to separate the oil, water and gas in the produced fluid stream	Numeric	Measured at the equipment by the user
T_{sp}	Separator temperature	The operating temperature of the separator measured in °F	Numeric	Provided by the user from field measurements
V_{MW}	Vapor Molecular Weight	The weight of one mole (or Avogadro's number of molecules) of the gas being measured.	Numeric	Determined by reference or measurement. May use default value or actual gas analysis.

Symbol	Name	Description	Type	Source
C1, C2, C3	Vasquez Beggs Constants	Constants calculated for the use in this relationship using stastical empirical data. Dimensionless	Numeric	Provided by reference to the relationship based on degree API gravity range of the crude being stored.
SG	Specific Gravity of the gas	Same as γ_{sp} or separator specific gravity as described above.	Numeric	Calculated using the physical data of the gas being measured
SG100	Specific gravity of the gas referenced to 100 psig	A calculated quantity based on the temperature and pressure measured at the separator referenced to 100 pounds per square inch gauge (psig) pressure.	Numeric	Result of equation 3.6.3
P_{str}	Pressure of the upstream fluid	Pressure of the fluid stream as it leaves the separator or the separator pressure.	Numeric	Measured in the field by the user.
P_{atm}	Atmospheric pressure	The measured pressure of ambient conditions or in the atmosphere outside the separator.	Numeric	Measured at the field location using a barometer or by default at ST&P.
T_{gas}	Gas temperature at the separator	The measured temperature of the gas stream in the separator	Numeric	Measured at the field location by the user.
P_{sep}	Separator Pressure	The operating pressure of the separator measured in psig	Numeric	Measured at the field location by the user.
psig	Pounds per square inch gauge	Pressure measurement in units of pounds per square inch or in general units - f/l^2.	Numeric	Measured with a pressure measuring device at the equipment site.
°API	Degrees API gravity	The measured API gravity of the fluid (crude) being measured as calculated by a standard equation which ratios the specific gravity of the fluid to a referenced standard.	Numeric	Calculated using the physical data of the fluid.
°F	Degrees Fahrenheit	The standard temperature measurement using degrees Fahrenheit as a scale.	Numeric	Standard unit
log	Logarithm	Mathematical relationship which equals the exponent value that the number 10 would be raised to get that same number.	Text	Standard unit

22. (New) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating loading loss emissions:

$$L_L = 12.46\frac{SPM}{T}$$

Symbol	Name	Description	Type	Source
L_L	Loading losses - VOC	The Volatile Organic Compound (VOC) emissions quantity as determined in the above equation.	Numeric	Result of equation 3.7.1
S	Saturation factor	Empirical quantity for calculation	Numeric	AP-42 reference Table 5.2-1. Stored in System Library.
P	True liquid vapor pressure of the liquid being loaded	The true vapor pressure of the liquid being loaded which is the pressure at which the liquid is in equilibrium with the overhead vapors. Measured in pounds per square inch atmospheric (psia)	Numeric	By reference from AP-42 Figures 7.1-5, 7.1-6, 7.1-2. Stored in System Library.
M	Vapor Molecular Weight	The weight per mole of gases being emitted, e.g lb/lb mole. One mole = weight of 10^{23} molecules (Avogadro's number) of the gas or 359 standard cubic feet. (SCF)	Numeric	By reference from AP-42 Table 7.1-2. Stored in System Library.
T	Bulk Liquid Temperature	The temperature of the liquid being loaded in °R (Rankine) = °F +460.	Numeric	Supplied from the tank calculation data.

REMARKS

Applicant acknowledges receipt of the "NOTICE OF OMITTED ITEM(S) IN A NONPROVISIONAL APPLICATION" mailed 07/09/2001. Applicant asserts that no new matter is added by this amendment because the missing pages included effected only the claims amended herein, which are fully supported by the properly filed specification.

In addition to the clean claims in this amendment and the marked up claims appended as required by the rules, the missing pages (22, 23, 25, 27, and 31) have been attached so that the examiner can better understand the amendments.

Please charge any necessary payment of fees for prosecution of the above-identified application to BRACEWELL & PATTERSON, LLP Deposit Account No. 50-0259.

Respectfully submitted,

Dated: 10/03/2001

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Marked up Claims:

13. (Amended) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating hydrocarbon emissions from storage tanks:

$$L_T = L_S + L_W$$

$$L_S = 365 V_V \; W_V \; K_E \; K_S$$

$$V_V = \frac{\pi}{4} D^2 (H_S - H_L + H_{RO})$$

$$W_V = \frac{M_V P_{VA}}{R T_{LA}}$$

$$T_{LA} = .044 T_{AA} + 0.56 T_B + 0.0079 aI$$

$$T_B = T_{AA} + 6a - 1$$

$$K_E = \frac{dT_V}{T_{LA}} + \frac{dP_V - dP_B}{P_A - P_{VA}}$$

$$dT_V = .072 dT_A + 0.028 I$$

$$K_S = \frac{1}{1 + 0.053 P_{VA} H_{VO}}$$

$$H_{VO} = H_S - H_L + H_{RO}$$

$$L_W = 0.0010 M_V P_{VA} Q K_N K_P$$

Symbol	Name	Description	Type	Source
π	Pi	Constant dimensionless factor = 3.1415	Numeric	Mathematical constant (given)
a	Tank paint solar absorbence factor	Dimensionless empirical factor which has been established through experience.	Numeric	Reference from Table 12.3-7 in AP42 reference and based on color. Stored in System Library.
D	Tank diameter	Cross sectional linear measurement of the cylindrical tank. Units=linear	Numeric	Client data stored in System Database
H_L	Liquid Height	Average daily tank gauge reading which shows how much is in the tank. Units=linear (e.g. ft)	Numeric	Client data stored in System Database

Symbol	Name	Description	Type	Source
H_{RO}	Roof Outage	Linear measurement of tank roof height measured from the vertical edge of the tank shell to the top of the dome or coned roof. Units = linear (l)	Numeric	Client data stored in System Database
H_S	Shell Height	Linear measurement of tank height excluding the height of the roof section of the tank. Units = linear (l)	Numeric	Client data stored in System Database
H_{VO}	Vapor Space Outage	The height of the inside tank space minus the liquid level in linear units, e.g. ft	Numeric	Result of Equation 3.1.10
I	Daily solar insolation factor	Empirical factor based on tank materials and conditions. Units = BTU / ft^3 - day	Numeric	Referenced from Table 12.3-6 in AP42 reference. Stored in System Library.
K_E	Vapor space expansion factor	Dimensionless empirical factor used to calculate standing losses in Equation (1)	Numeric	Result of Equation 3.1.7
K_N	Turnover factor	Dimensionless empirical factor	Numeric	Taken from Figure 12.3-6 in AP42 reference. Stored in System Library.
K_P	Working loss product factor	Dimensionless empirical factor which is product specific, i.e. 0.75 for crude oil and 1.0 for all other organic liquids.	Numeric	Included by reference. Stored in System Library.
K_S	Vented Vapor Saturation Factor	Dimensionless factor used to calculate the Standing Storage Losses.	Numeric	Result of Equation 3.1.9
L_S	Standing Losses	Hydrocarbon air emissions from crude and condensate above ground storage tanks that are given off while the tank is standing idle (not filling and emptying) and contains some quantity of fluid. Measured in lbs/hr, lbs/day, and tons/year.	Numeric	Result of Equation 3.1.2
L_T	Total losses	Hydrocarbon air emissions from crude and condensate above ground storage tanks that are a sum of the working and standing losses as described above. Measured in lbs/hr, lbs/day, and tons/year.	Numeric	Result of Equation 3.1.1

Symbol	Name	Description	Type	Source
L_W	Working Losses	Hydrocarbon air emissions from crude and condensate above ground storage tanks that are given off during operations (filling and emptying) and contains some quantity of fluid. Measured in lbs/hr, lbs/day, and tons/year.	Numeric	Result of Equation 3.1.11
Mv	Vapor Molecular Weight	Molecular weight or the weight of an Avogadro's number of molecules of the gases in the vapor space volume. Units = mass/mole (e.g. lb/lb mole)	Numeric	Taken from reference tables in the AP42 reference. Stored in System Library.
P_A	Atmospheric pressure	Standard ambient atmospheric pressure as measured via barometer, e.g. 14.7 psia	Numeric	Constant by reference. Stored in System Library.
dP_B	Breather vent pressure setting range.	The range in pressures at which the tank vent or hatch will relieve under the pressure of its contents.	Numeric	Client data stored in System Database. Otherwise the program will provide a default value if the user chooses.
dPv	Daily vapor pressure range	The range (or change) in the vapor pressure caused by the variance in maximum and minimum daily ambient temperatures. Provided by reference in pressure measurements.	Numeric	Derived from Figure 12.3-1 and Table 12.3-6 in AP42 reference. Stored in System Library.
P_{VA}	Vapor pressure	True vapor pressure of the liquid at the average liquid surface temperature. Units = force / unit area (f/l^2) (lbs/ $inch^2$)	Numeric	Vapor sample data stored in System Database or table in AP42 reference stored in System Library.
Q	Annual net production through-put	The annual volume of hydrocarbons, e.g. crude oil, that is stored in the tank being considered. This figure is taken from actual lease production volumes. Volumetric units, e.g. bbls	Numeric	Client data stored in System Database
R	Ideal Gas Constant	Ideal gas constant calculated as (standard atmospheric pressure - ideal molar volume of gas / mole - standard temperature) (e.g. psia - ft^3 / lb-mole - °R (Rankine) = 10.731)	Numeric	Calculated from constants / Almost always used in USA as 10.731. Stored in System Library.

Symbol	Name	Description	Type	Source
dT_A	Daily average temperature range (°R ,°K)	The difference between daily minimum and maximum temperatures taken from Table 12.3-6 as determined by regional location.	Numeric	Taken from Table 12.3-6 in AP42 reference. Stored in System Library.
T_{AA}	Daily average ambient temperature	Average of daily maximum and minimum ambient temperatures. Measured in °R or °K.	Numeric	Table 12.3 in AP42 reference. Stored in System Library.
T_B	Liquid bulk temperature	Liquid bulk temperature at standard temp Units = °R or °K	Numeric	Result of Equation 3.1.6
T_{LA}	Daily average liquid surface temperature	The average temperature measured at the surface of the liquid in the tank. In this case the temperature is calculated from ambient temperatures rather that measured. Units = °R(Rankine)	Numeric	Result of Equation 3.1.5
dTv	Daily vapor temperature range	The daily range in temperature of the vapor in the vapor space of the tank as described above; calculated.	Numeric	Result of Equation 3.1.8
Vv	Vapor space volume	Volumetric calculation of the average amount of space in the tank (overhead) that is not occupied by liquids. Measurement = l^3	Numeric	Result of Equation 3.1.3
Wv	Vapor density	Calculated density of the gases(vapors) in the vapor space calculated in equation (1)(a) Units= mass/unit volume (m/l^3) (e.g. lb/ft^3)	Numeric	Result of Equation 3.1.4

14. (Amended) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating hydrocarbon emissions from internal combustion engines:

~~Symbol~~	~~Name~~	~~Description~~	~~Type~~	~~Source~~
~~EF~~	~~Emission Factor lb / mmscf~~	~~Amount of pollutant species generated per unit of fuel used or burned, e.g. lbs (pounds) per mmscf (Million standard cubic feet) of gas burned.~~	~~Numeric~~	~~Client data stored in System Database~~

~~Symbol~~	~~Name~~	~~Description~~	~~Type~~	~~Source~~
~~mmbtu~~	~~BTU rating of the unit~~	~~The size of the combustion unit as measured in BTU's per hour. mmbtu = million British Thermal Units~~	~~Numeric~~	~~Client data stored in System Database~~

$$\sum_{i=1 \text{ to } n} \frac{EF_i\ g}{1\ hp\ hr} \times \frac{\text{Rated } hp_i}{1} \times \frac{24 \text{ hrs}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ lb}}{453.6 \text{ g}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \frac{\text{Emissions tons}}{\text{year}}$$

Symbol	Name	Description	Type	Source
EF	Emission Factor g/hp/hr	The amount of an individual pollutant that will be generated per horse power hour of operation, e.g. 2.0 grams NOx generated in grams per hp per hour.	Numeric	Provided by the user or obtained from the equipment data base by the id number or model of compressor
HP (hp)	Horse power rating	The power rating of the compressor in horse power per hour	Numeric	Provided by the user or obtained from the equipment data base by the id number or model of compressor

15. (New) The method of claim 14, wherein the primary formula is repeated for each of the following pollutants:

NOx	Nitrous Oxides	Nitrous oxide emissions	Calculated from AP-42 emission factors or manufacturers data.
CO	Carbon Monoxide	Carbon monoxide emissions	Calculated from AP-42 emission factors or manufacturers data.
SO_2	Sulfur dioxide	Sulfur dioxide emissions	Calculated from AP-42 emission factors or manufacturers data.
PA or PM_{10}	Particulates	Particulate emission from fuel combustion	Calculated from AP-42 emission factors or manufacturers data.
VOCnm	Non-methane Volatile Organic Compounds	Measurement of emissions of VOC's as tons per year.	AP-42 emission factors or manufacturers data.

16. (New) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating hydrocarbon emissions from external combustion units:

$$\sum_{i=1 \text{ to } n} \frac{mmBTU_i}{hr} \times \frac{1\ SCF}{\text{Fuel Heat Value in } BTU} \times \frac{EF\ lbs}{mmSCF} \times \frac{24 \text{ hrs}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \frac{\text{Emissions tons}}{\text{year}}$$

Symbol	Name	Description	Type	Source
EF	Emission Factor lb / mmscf	Amount of pollutant species generated per unit of fuel used or burned, e.g. lbs (pounds) per mmscf (Million standard cubic feet) of gas burned.	Numeric	Client data stored in System Database
mmbtu	BTU rating of the unit	The size of the combustion unit as measured in BTU's per hour. mmbtu = million British Thermal Units	Numeric	Client data stored in System Database

19. (Amended) The method of claim 18, wherein the primary formula is repeated for each fitting in each piece of equipment:

Symbol	Name	Description	Type	Source
EF	Emission Factor	Amount of volatile organic emissions generated per fugitive component or source. E.G. lbs / hour / source	Numeric	Provided by reference from AP42 and SOCMI.
No. of components, (src)	Number of components	Actual number of each source component at the facility, e.g 355 valves, etc.	Numeric	Provided by the user or obtained from Client data stored in System Database or equipment data stored in System Library
VOC%	VOC Concentration in the affected stream	The concentration of VOC (volatile organic hydrocarbon compounds) defined as any compound with C3+ hydrocarbons as identified in the gas analysis and as calculated by volume %.	Numeric	Calculated from the gas analysis for this facility.

	~~Lean TEG/ EG flow rate~~	~~The pumping rate of the lean or fresh tri-ethylene glycol (or ethylene glycol) solution in gallons per minute~~	~~Numeric~~	~~Client data stored in System Database~~

	Water content	The allowable water concentration in the lean or fresh glycol stream. A default value of 1.5% may be chosen if the user does not have this value	Numeric	Client data stored in System Database or chosen by default
	Re-circulation ratio	The gallons of glycol solution circulated per pound of water removed from the wet gas stream if known. May be chosen in place of the lean TEG/EG flow rate. Default value of 0.3 may be chosen in the program.	Numeric	Client data stored in System Database
	Wet Gas Temperature	Temperature of the incoming wet gas stream in °F.	Numeric	Client data stored in System Database
	Wet gas pressure	Pressure of the incoming wet gas stream in psig.	Numeric	Client data stored in System Database
	Glycol pump type	May be gas driven or electric	Text	Client data stored in System Database
ACFM / gal	Gas driven pump volume ratio	ACFM (air cubic feet per minute) gas / gallon per minute glycol pumped (only for gas driven pumps) May choose default values of 0.03 for wet gas pressures greater than 40 psig and 0.08 for units with wet gas pressures less than 400 psig.	Numeric	Client data stored in System Database
	Flash Tank	Yes or no question. Is a flash tank involved with this unit.	Text	Client data stored in System Database
	Flash tank temperature	Operating temperature of the flash tank if used in °Fahrenheit (°F)	Numeric	Client data stored in System Database
PSIG	Flash tank pressure	Operating pressure of the flash tank if used. Psig (pounds per square inch gauge)	Numeric	Client data stored in System Database
	Stripping gas option	Yes or no question. Is a gas stream used to remove the hydrocarbons from the glycol vent stream?	Text	Client data stored in System Database
	Stripping gas flow rate	Flow rate of the stripping gas stream, scfm	Numeric	Client data stored in System Database
	Control device option	Choose a control device as either a vent condenser or vapor incinerator, or choose no control device.	Text	Client data stored in System Database
	Vent condenser temperature	Operating temperature of the vent condenser (if used) in °F	Numeric	Client data stored in System Database

	Vent condenser pressure	Operating pressure of the vent condenser (if used) in absolute pressure, e.g. psia	Numeric	Client data stored in System Database
	Incinerator ambient air temperature	Average ambient air temperature for the location in °F	Numeric	Selected from climatic data stored in System Library
	Excess oxygen	% excess oxygen used in combustion process if a vapor incinerator is chosen as a control device.	Numeric	Provided by the manufacturer of the combustion unit and included in the System Library
	Combustion efficiency	% efficiency of the vapor control incinerator unit.	Numeric	Provided by the manufacturer of the combustion unit and included in the equipment data base.
VOCs	Volatile Organic Compounds	Measurement of emissions of VOC's as tons per year from the Glycalc Program Printout in tons/year	Numeric	Glycalc® program output
HAPs	Hazardous Air Pollutants	Volumetric measurement of a group of air constituents that have been determined by the Environmental Protection Agency (EPA) to be considered categorically hazardous to health and the human environment. Measured in tons/year	Numeric	Glycalc® program output or information gained from the EPA speciation program for HAP's.

20. (New) The method of claim 18, wherein the mathematical database includes the primary calculation formula for calculating emissions for glycol dehydration units, wherein:

Symbol	Name	Description	Type	Source
	Unit Description	Case name and case description used to retrieve case files from the GRI program. This name will also be identified by a facility ID number and an equipment ID number.	Text	Provided by the user or taken from the facility data base as a facility name.
	Annual Hours of Operation	Number of hours the unit operates annually, e.g 8760 hrs = 1 year	Numeric	Input by user or user data base.

Symbol	Name	Description	Type	Source
	Gas Composition	Percentages of all components in the gas stream. Individual values input separately from gas analysis.	Numeric and text	Gas analysis provided by user or from Client data stored in System Database
mmscf / day	Dry gas flow rate	The volumetric flow of the sales gas stream in volumetric units per day (e.g. mmscf/day or million standard cubic feet per day)	Numeric	Production data from user or Client data stored in System Database
lb / mmwscf	Dry gas water content	The target final concentration of water in the sales gas stream, in the USA the default value is 7.0 lb / mmscf	Numeric	Client data stored in System Database or accepted by default
	Absorber stages	Number of actual equilibrium stages in the contactor; may be chosen, if known, by the user as an alternative entry to the dry gas water content described above.	Numeric	Chosen by user
	Lean TEG/ EG flow rate	The pumping rate of the lean or fresh tri-ethylene glycol (or ethylene glycol) solution in gallons per minute	Numeric	Client data stored in System Database
	Water content	The allowable water concentration in the lean or fresh glycol stream. A default value of 1.5% may be chosen if the user does not have this value	Numeric	Client data stored in System Database or chosen by default
	Re-circulation ratio	The gallons of glycol solution circulated per pound of water removed from the wet gas stream if known. May be chosen in place of the lean TEG/EG flow rate. Default value of 0.3 may be chosen in the program.	Numeric	Client data stored in System Database
	Wet Gas Temperature	Temperature of the incoming wet gas stream in °F.	Numeric	Client data stored in System Database
	Wet gas pressure	Pressure of the incoming wet gas stream in psig.	Numeric	Client data stored in System Database
	Glycol pump type	May be gas driven or electric	Text	Client data stored in System Database
ACFM / gal	Gas driven pump volume ratio	ACFM (air cubic feet per minute) gas / gallon per minute glycol pumped (only for gas driven pumps) May choose default values of 0.03 for wet gas pressures greater than 40 psig and 0.08 for units with wet gas pressures less than 400 psig.	Numeric	Client data stored in System Database

Symbol	Name	Description	Type	Source
	Flash Tank	Yes or no question. Is a flash tank involved with this unit.	Text	Client data stored in System Database
	Flash tank temperature	Operating temperature of the flash tank if used in °Fahrenheit (°F)	Numeric	Client data stored in System Database
PSIG	Flash tank pressure	Operating pressure of the flash tank if used. Psig (pounds per square inch gauge)	Numeric	Client data stored in System Database
	Stripping gas option	Yes or no question. Is a gas stream used to remove the hydrocarbons from the glycol vent stream?	Text	Client data stored in System Database
	Stripping gas flow rate	Flow rate of the stripping gas stream, scfm	Numeric	Client data stored in System Database
	Control device option	Choose a control device as either a vent condenser or vapor incinerator, or choose no control device.	Text	Client data stored in System Database
	Vent condenser temperature	Operating temperature of the vent condenser (if used) in °F	Numeric	Client data stored in System Database
	Vent condenser pressure	Operating pressure of the vent condenser (if used) in absolute pressure, e.g. psia	Numeric	Client data stored in System Database
	Incinerator ambient air temperature	Average ambient air temperature for the location in °F	Numeric	Selected from climatic data stored in System Library
	Excess oxygen	% excess oxygen used in combustion process if a vapor incinerator is chosen as a control device.	Numeric	Provided by the manufacturer of the combustion unit and included in the System Library
	Combustion efficiency	% efficiency of the vapor control incinerator unit.	Numeric	Provided by the manufacturer of the combustion unit and included in the equipment data base.
VOCs	Volatile Organic Compounds	Measurement of emissions of VOC's as tons per year from the Glycalc Program Printout in tons/year	Numeric	Glycalc® program output

Symbol	Name	Description	Type	Source
HAPs	Hazardous Air Pollutants	Volumetric measurement of a group of air constituents that have been determined by the Environmental Protection Agency (EPA) to be considered categorically hazardous to health and the human environment. Measured in tons/year	Numeric	Glycalc® program output or information gained from the EPA speciation program for HAP's.

21. (Amended) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating flash emissions caused by the transfer of higher pressure liquids from a process vessel to a storage tank of less pressure:

$$\log R_{st} = 0.4896 - 4.916 \log \gamma_{ost} + 3.496 \log \gamma_{sp} + 1.501 \log P_{sp} - 0.9213 \log T_{sp}$$

and the Vasquez Beggs GOR Correlation.

$$GOR = C1 \times SG100 \times (P_{str} + P_{atm})^{C2} \times e^{\frac{C3 \times {}^{\circ}API}{T_{gas}{}^{\circ}F + 460}}$$

$$SG100 = SG \times (1.0 + 5.912 \times 10^{-5} \times T_{gas}{}^{\circ}F \times \log \frac{P_{sep} + P_{atm}}{114.7}$$

Symbol	Name	Description	Type	Source
R_{st}	Stock Tank Gas Oil Ratio (GOR)	The ratio of the volume of gas generated per barrel of oil produced as a result of the pressure drop between the pressurized separator and the oil storage (stock) tank. Units = volume gas / volume oil, e.g standard cubic feet / barrel	Numeric	Calculated by Black Oil GOR equation, 3.6.1
γ_{ost}	Stock Tank Oil specific gravity	Measurement of the ratio of the weight of the oil relative to water at standard temperature and pressure. E.g. units = lb/gal per lb/gal or SG=6.5 lb/gal oil / 8.34 lb/gal water @STP = 0.78	Numeric	Calculated using the physical data of the materials being stored
γ_{sp}	Separator specific gravity	Measurement of the ratio of the weight of the air relative to	Numeric	Calculated using the physical data of the gas being measured
P_{sp}	Separator pressure	The operating pressure of the vessel used to separate the oil, water and gas in the produced fluid stream	Numeric	Measured at the equipment by the user

Symbol	Name	Description	Type	Source
T_{sp}	Separator temperature	The operating temperature of the separator measured in °F	Numeric	Provided by the user from field measurements
V_{MW}	Vapor Molecular Weight	The weight of one mole (or Avogadro's number of molecules) of the gas being measured.	Numeric	Determined by reference or measurement. May use default value or actual gas analysis.
C1, C2, C3	Vasquez Beggs Constants	Constants calculated for the use in this relationship using stastical empirical data. Dimensionless	Numeric	Provided by reference to the relationship based on degree API gravity range of the crude being stored.
SG	Specific Gravity of the gas	Same as γ_{sp} or separator specific gravity as described above.	Numeric	Calculated using the physical data of the gas being measured
SG100	Specific gravity of the gas referenced to 100 psig	A calculated quantity based on the temperature and pressure measured at the separator referenced to 100 pounds per square inch gauge (psig) pressure.	Numeric	Result of equation 3.6.3
P_{str}	Pressure of the upstream fluid	Pressure of the fluid stream as it leaves the separator or the separator pressure.	Numeric	Measured in the field by the user.
P_{atm}	Atmospheric pressure	The measured pressure of ambient conditions or in the atmosphere outside the separator.	Numeric	Measured at the field location using a barometer or by default at ST&P.
T_{gas}	Gas temperature at the separator	The measured temperature of the gas stream in the separator	Numeric	Measured at the field location by the user.
P_{sep}	Separator Pressure	The operating pressure of the separator measured in psig	Numeric	Measured at the field location by the user.
psig	Pounds per square inch gauge	Pressure measurement in units of pounds per square inch or in general units - f/l^2.	Numeric	Measured with a pressure measuring device at the equipment site.

Symbol	Name	Description	Type	Source
°API	Degrees API gravity	The measured API gravity of the fluid (crude) being measured as calculated by a standard equation which ratios the specific gravity of the fluid to a referenced standard.	Numeric	Calculated using the physical data of the fluid.
°F	Degrees Fahrenheit	The standard temperature measurement using degrees Fahrenheit as a scale.	Numeric	Standard unit
log	Logarithm	Mathematical relationship which equals the exponent value that the number 10 would be raised to get that same number.	Text	Standard unit

~~Symbol~~	~~Name~~	~~Description~~	~~Type~~	~~Source~~
~~M~~	~~Vapor Molecular Weight~~	~~The weight per mole of gases being emitted, e.g lb/lb mole. One mole = weight of 10^{29} molecules (Avogadro's number) of the gas or 359 standard cubic feet. (SCF)~~	~~Numeric~~	~~By reference from AP-42 Table 7.1-2. Stored in System Library.~~
~~T~~	~~Bulk Liquid Temperature~~	~~The temperature of the liquid being loaded in °R (Rankine) = °F +460.~~	~~Numeric~~	~~Supplied from the tank calculation data.~~

22. (New) The method of claim 12, wherein the mathematical database includes the following primary calculation formulas for calculating loading loss emissions:

$$L_L = 12.46\frac{SPM}{T}$$

Symbol	Name	Description	Type	Source
L_L	Loading losses - VOC	The Volatile Organic Compound (VOC) emissions quantity as determined in the above equation.	Numeric	Result of equation 3.7.1
S	Saturation factor	Empirical quantity for calculation	Numeric	AP-42 reference Table 5.2-1. Stored in System Library.

Symbol	Name	Description	Type	Source
P	True liquid vapor pressure of the liquid being loaded	The true vapor pressure of the liquid being loaded which is the pressure at which the liquid is in equilibrium with the overhead vapors. Measured in pounds per square inch atmospheric (psia)	Numeric	By reference from AP-42 Figures 7.1-5, 7.1-6, 7.1-2. Stored in System Library.
M	Vapor Molecular Weight	The weight per mole of gases being emitted, e.g lb/lb mole. One mole = weight of 10^{23} molecules (Avogadro's number) of the gas or 359 standard cubic feet. (SCF)	Numeric	By reference from AP-42 Table 7.1-2. Stored in System Library.
T	Bulk Liquid Temperature	The temperature of the liquid being loaded in °R (Rankine) = °F +460.	Numeric	Supplied from the tank calculation data.